Burwen Research

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SERVICE NOTES

DYNAMIC NOISE FILTER

MODEL DNF 1201A

CIRCUIT DESCRIPTION

BASIC FUNCTIONS

The DNF 1201A Dynamic Noise Filter consists of a common bandwidth controller and separate voltage variable low-pass filters for each of the left and right channels. The bandwidth controller receives the sum of the two input signals and delivers a negative dc control voltage which is dependent upon the high frequency content of the program source and the sensitivity potentiometer setting. A higher frequency or higher input amplitude produces more output. Normally the system is set so the hiss from the program source produces a small dc output and any high frequency signal beyond the hiss level is deemed to be music and adjuststhe bandwidth accordingly.

The voltage variable low-pass filters in each channel attenuate at 9 dB/octave at frequencies varying from 500 Hz to 30 kHz. The bandwidth varies over a 60 to 1 range as the dc control voltage varies over a 300 to 1 range.

VOLTAGE VARIABLE LOW-PASS FILTER

In the schematic diagram the left and right channels are identical. The left input passes through the pre-post switch to the input level pot R1 and then to pin 13 of A1. The input buffer amplifier has a maximum gain of 11 dB and can be used to boost the signal in situations where the source signal is low. Normally the input level pot is set at approximately -9 dB which produces unity gain through the system.

The voltage variable low-pass filter consists of the integrator A1, pins 4, 5, and 6 and MOSFET Q1A which is used as a voltage variable resistor which adjusts the time constant of the integrator. Overall feedback from the output, pin A1, pin 4 to the input summing junction at R10 and R13 flattens the response within the passband. The integrating capacitor consists of C7 plus a complex network consisting of R14, R19, R20, C8, and C9 used to attenuate high frequencies at 9 dB/octave total. Amplifier A1, pins 8, 9, and 10 is used for cancelling distortion in Q1A. This amplifier provides an adjustable gain for approximately 8 and by means of the divider R17 and R18 maintains the gate of the voltage midway between the drain and source so as to cancel second harmonic distortion. The source pin 11 is held at virtual ground potential by the feedback around A1 to pin 6.

BANDWIDTH CONTROLLER

The bandwidth controller consists of A2, pins 1, 2, and 3, A3, A4, and pins 1, 2, and 3 of A1. The outputs of the buffer amplifiers, A1 pin 12 and A2 pin 12, are summed via R48 and R49 at the positive input of A2 pin 2. Low frequencies are attenuated below 400 Hz and high frequencies are attenuated above 15 kHz. The feedback network around A2 increases the high frequency gain at 6 dB/octave from 600 Hz and peaks at 10 kHz. When the MAX pushbutton is depressed C24 lowers the peak frequency to approximately 4.5 kHz. The output from A2 pin 3, which then has a slope of approximately 6 dB/octave upward, then passes through the sensitivity control, R56, to the compression amplifier A3. A low-pass filter R53, R54, and C26 at the input provides a 12 dB/octave attenuation above 12 kHz with corner peaking provided by feedback from the junction of R57 and R59.

For large signals, the diodes in the feedback network, CR1, CR2, CR3, and CR4, become an effective short-circuit and the amplifier has a flat gain of approximately 20 dB above 100 Hz. For very small signals, the diodes become an open circuit and capacitor C32 is inserted in the feedback path to increase the low frequency gain. The net result is that the first amplifier and second amplifier combined having the frequency response at pin 10 of A3 nearly flat to 10 kHz for small signals and falling off at 6 dB/ octave below 10 kHz for large signals. The amplitude of the signal at pin 10 of A3 changes rather slowly with the input at middle frequencies because of the compression effects at the diodes. Following the compression amplifier is a precision full wave rectifier circuit A3, pins 12, 13, and 14 and A3, pins 1, 2, and 3. The input to this rectifier has a 6 dB/octave characteristic rising towards the high frequencies as a result of the capacitor C31 and input resistor R63. In combination with the diode compression circuit, which tends to produce a clipped output signal at A3 pin 10 having a a fairly constant amplitude vs frequency, the differentiation circuit produces an input current to the full wave rectifier which increases in direct proportion to the incoming frequency but varies very slowly with the input amplitude.

At the output of the full wave rectifier, A3 pin 3, the signal is then peak detected by a peak rectifier consisting of CR9, CR10, capacitor C35, and the feedback amplifier A3, pins 4, 5, and 6 with the output follower Q2. By sampling the output of CR10 to provide the feedback to pin 6, A3, the effects of the .5 V breakdown voltages of CR9 and CR10 are eliminated, thereby making a precision peak rectifier which operates from 10 V peak down to millivolt levels. Switches S4A MIN and S5A MED adjust the charging time constant and affect the speed with which the bandwidth can change in response to incoming transients such as cymbals and castanets.

A complex discharge network is used to determine the decay of the voltage across C35 upon cessation of the signal. To best follow the decay of a transient signal, C35 is allowed to discharge rapidly in approximately 40 ms or part of the way corresponding to bandwidths in the range from 20 kHz down to 4 kHz. Below 4 kHz the charge on C35 decays very slowly and takes more than a second to discharge completely. This slow decay in the narrower bandwidth region is used to produce a smoother sounding control action. Rapid decay in the upper bandwidths is produced by resistor R73 which conducts thru diodes CR7 and CR8. Once the voltage across CR7 and CR8 reaches approximately 1 V the discharge time constant is much longer and is determined by C33 and R70 at a bandwidth of approximately 2 kHz. Below 2 kHz the discharge of C33 is largely determined by the resistor R72. To prevent a tick on a record from causing a slow discharge with a consequent burst of hiss following the tick, C33 is prevented from charging rapidly by resistors R74, R75, and R77. Also, even for sustained signals, the amount of charge is limited by diodes CR7 and CR8 and the charging time is prevented from being too short by diodes CR11, CR12, and CR13. In summary, a sustained signal will charge C33 to approximately 1 V whereas a tick, which lasts only microseconds, will produce very little charge.

The dc output across capacitor C35 is amplified by a nonlinear amplifier A4. The diode CR14 in the feedback path is biased as to provide an additional gain of 10 dB when the dc output corresponds to a bandwidth of 7 kHz or more. The purpose of this amplifier is to assure that full 20 kHz bandwidth occurs for higher level signals without requiring

that the signals reach the maximum signal level. A second stage of filtering on the dc control voltage is provided by R88, R94, and C38. This extra filtering eliminates ripple on the dc control voltage which would otherwise distort the signal by modulating its phase. However, to prevent degradation of the attack time a fast charging amplifier A4, pins 4, 5, and 6 is provided. This amplifier will charge capacitor C38 to 50% of the output at A4 pin 3 whenever a sharp transient occurs. Resistor R89 and capacitor C37 simulate the time constant of C38, R88, and R94 and determine when A4 pin 4 fires to charge C38. Charging occurs whenever a peak comes along which is approximately 5 dB above the average charge on C37 and this ratio is determined by R86 and R87. Capacitor C36 provides a 300 us charging time constant to somewhat smooth the leading edge of the dc control voltage following a transient. At the output of C38, amplifier A4, pins 12, 13, and 14 provide an additional gain of three times and operates the suppression and wideband LEDs. Amplifier 1, pins 1, 2, and 3 augments the current output to deliver approximately 15 mA to each LED.

At test point 7, a dc control voltage is developed in the range from 0 to -10 V. This dc control voltage is then fed to A4, pins 8, 9, and 10, which is a modeling circuit used to develop the proper bias for the voltage variable resistors Q1A and Q1B. Using the third section of Q1, which is inherently well matched to Q1A and Q1B because of the monolithic construction, an output is developed from A4 pin 10 representing the bias required to produce proper conductance in Q1C as determined by the dc control voltage at TP7. This amplifier is thus able to linearize the control characteristics of Q1A and Q1B and produce a conductance which varies linearly with the dc control voltage at TP7 over a 300 to 1 range.

POWER SUPPLIES

The power supplies are conventional and utilize separate positive and negative regulators to produce ±15 V, ±5% at 65 mA. Dual windings on the primary of the transformer permit connections for either 115 V or 230 V operation. Different line fuse values are used for the two different voltages.

TROUBLESHOOTING THE DNF 1201A

Problems in the DNF 1201A can be localized by listening to the unit separately on each channel and watching the front panel LEDs as the sensitivity control is varied. For example, if power is applied and neither LED lights, the trouble is likely to be in the power supply section. Check the fuse inside the unit and, if it is blown, before turning the power on again find the cause of the blown fuse. If the LEDs operate improperly, the trouble is likely to be in the bandwith controller section. If both LEDs operate properly on a variety of program material and the high frequencies are either continually cut off or continually coming through with no noise reduction, regardless of pushbutton settings, then check the voltage variable low-pass filters.

The system can be checked out on the bench using the following performance verification procedure:

PERFORMANCE VERIFICATION

This procedure is recommended for a general bench checkout of all important operating characteristics of the Burwen DNF 1201A. Upon completion of repair, use this set of tests for final performance measurements.

EQUIPMENT REQUIREMENTS

1. DC voltmeter (greater than 1 Mohm input resistance)
2. Sine wave generator
   Krohn-Hite 4300 or equivalent
3. AC millivolt meter (greater than 1 Mohm input impedance)
4. Harmonic distortion analyzer
   HP - 333A or equivalent
5. Oscilloscope
   10 mV/cm vertical sensitivity, and external horizontal input

Note:
Allow approximately three minutes warmup time with the unit in the OUT mode before making measurements. Connect a 5k load to the output of each channel. The reference level of 0 dB is 0.775 V. rms.

1.0 Wide Band Frequency Response
- 1.1 Connect the oscillator to both the left and right inputs. Set the level at 200 Hz, 0 dB. Depress OUT. The green LED should be on.
- 1.2 Connect the ac voltmeter to the left output. The output level should be 0 ±0.05 dB. Adjust the left input level control if necessary.
- 1.3 Frequency response, 20 Hz - 20 kHz, should be 0 ±0.5 dB.
- 1.4 Repeat steps 1.2 and 1.3 for the right channel.

2.0 Filter Tracking

2.1 Set the oscillator at 500 Hz, -20 dB. Depress MAX and set SENSITIVITY control to 0. The red LED should be on. The left output should be -23 $\pm$1.0 dB.

2.2 Set the oscillator at 1 kHz, -20 dB. Monitor the left output and adjust the SENSITIVITY control until the output is -23.0 dB. The right output should be -23.0 $\pm$1 dB.

2.3 Repeat steps 2.1 and 2.2 using 3 kHz, 5 kHz, and 20 kHz.

3.0 10 kHz Distortion Measurement

3.1 Depress OUT. Measure the 10 kHz distortion of each channel at 2.5 V rms output. The distortion should be less than or equal to 0.2% THD.

4.0 Output Noise Measurement

Note: The unit must either be in the case or adequately shielded by a grounded metal plate so as to avoid hum pickup from nearby lights and power cords. Measurements should be made through a 20 Hz - 20 kHz bandpass filter. The warmup conditions at the beginning of this procedure should be noted. An accompanying dc transient which may result when changing from OUT to any of the other modes (and in reverse order) should not exceed 3 mV.

5.0 Pre/Post and Tape Monitor Switches

5.1 Jumper the TAPE RECORD jacks to the TAPE PLAY jacks. Feed in 0 dB @ 1 kHz. The system should deliver an output signal for any combination of the PRE POST and TAPE MONITOR switches.

ALIGNMENT POTENTIOMETERS

Unless one of the internal potentiometers has been replaced or inadvertently turned, it is recommended that they not be touched even when components are replaced, except for readjustment of the input level pots in accordance with the foregoing procedure. In general, the initial factory alignment will remain close enough even with changes in ICs. Should realignment be necessary, the following will help in understanding the functions of the various potentiometers. Use an input signal level of -20 dB.

R11 and R33 - adjust the left and right channel frequency response to flat at 20 kHz.
R115 - adjust the 500 Hz cutoff for both channels in test 2.0 above.
R47 - adjust the right channel to match the left channel at 500 Hz.
R91 - adjust for 0 $\pm$5 mV at TP7 with the input shorted and SENSITIVITY at 0.
R9 - adjust the total harmonic distortion in the left channel at 3 kHz, 2.5 V rms input with the SENSITIVITY control set to reduce the channel output to 1 V rms. This pot nulls the second harmonic on a Lissajous pattern of distortion vs input.
R31 - adjust the distortion in the right channel.

REPLACEMENT OF IC'S

When a fault is isolated to one of the major portions of the systems such as the power supply, bandwidth controller, or voltage variable bandpass filter in either channel, troubles can frequently be pinpointed quickly by either replacing IC's one by one or by measuring the dc and ac voltages at their output pins. To avoid slight inaccuracies in the alignment after replacement of IC's, do not mix them up. Label each IC before removal and replace it in its same socket if it is not defective.

CAUTION:
TO AVOID DAMAGE, DO NOT REMOVE OR REPLACE COMPONENTS WHILE THE POWER IS ON. THE CMOS INTEGRATED CIRCUIT Q1 IS SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC CHARGES FROM CLOTHING AND SOLDERING IRONS. OBSERVE PROPER GROUNDING PRECAUTIONS WHILE HANDLING.